

AD-A138 504

THE EARTH SYNCHRONOUS SATELLITE CARRIER ROCKET(U)
FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH Y ZHOU
26 JAN 84 FTD-ID(RS)T-1787-83

1/1

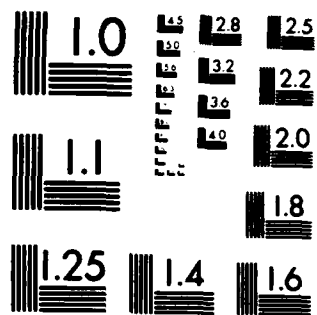
UNCLASSIFIED

F/G 22/4

NL



				END
				DATE
				FILED
				3 84
				DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FOREIGN TECHNOLOGY DIVISION



THE EARTH SYNCHRONOUS SATELLITE CARRIER ROCKET

by

Zhou Yiyun



DTIC
ELECTRONIC
MAR 2 1984
A

Approved for public release;
distribution unlimited.

DTIC FILE COPY

84 03 01 071

ADA138504

EDITED TRANSLATION

FTD-ID(RS)T-1787-83

26 January 1984

MICROFICHE NR: FTD-84-C-000094

THE EARTH SYNCHRONOUS SATELLITE CARRIER ROCKET

By: /Zhou Yiyun

English pages: 13

Source: Hangkong Zhishi, Nr. 8, August 1983, pp. 6-8

Country of origin: China

Translated by: SCITRAN

F33657-81-D-0263

Requester: FTD/SDBS

Approved for public release; distribution unlimited.

THIS TRANSLATION IS A RENDITION OF THE ORIGINAL FOREIGN TEXT WITHOUT ANY ANALYTICAL OR EDITORIAL COMMENT. STATEMENTS OR THEORIES ADVOCATED OR IMPLIED ARE THOSE OF THE SOURCE AND DO NOT NECESSARILY REFLECT THE POSITION OR OPINION OF THE FOREIGN TECHNOLOGY DIVISION.

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP. AFB, OHIO.

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.



A-1

THE EARTH SYNCHRONOUS SATELLITE CARRIER ROCKET

by Zhou Yiyun

Last September, the fight for the champion of the Women's World Volleyball Championships was held in a gymnasium in Lima, Peru. We sat in front of the television and witnessed this struggle happening on that ocean shore. Do you know how we can directly view the scene on the "back side" of the earth on a television screen? This was realized by means of an earth synchronous satellite.

What is an earth synchronous satellite? Satellites in which the moving period and earth's rotational period (1,436 minutes) are the same and the angular velocity with the same earth rotation rotates around the north-south axis of the earth are called earth synchronous satellites (abbreviated as synchronous satellite below). If the orbital plane of the synchronous satellite matches the equatorial plane, then it is also called the stationary satellite. Even if it rotates around the earth at a speed of 3,067 kilometers per second at an altitude of 35,800 kilometers, yet when we look at this satellite from the ground, it resembles a precious stone set on the vault of heaven which is absolutely still. A synchronous satellite can cover over one-third of the earth's surface taking the lower point of the satellite (located above the equator) as the center. Therefore, if we deploy three satellites at 120 degree longitudinal intervals, we can then

cover the whole earth outside the polar regions (Figure 1). At present, this type of satellite is mainly used for inter-continental communication, television broadcasting, weather observations and ballistic missile advance warnings etc.

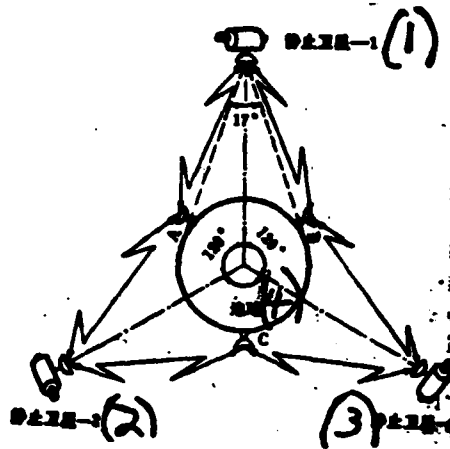


Fig. 1 Schematic of three stationary satellites realizing whole earth covering.

Key: (1) Stationary satellite-1; (2) Stationary satellite-2; (3) Stationary satellite-3; (4) Earth.

How are Synchronous Satellites Launched?

In order to send a several hundred kilogram to many ton man-made satellite from earth into a circular orbit at an altitude of 35,800 kilometers, it is necessary to specially launch carrier rockets of this type of satellite. To use the lowest energy consumption to complete this launching task, the general launching process goes through three stages. When the number of the launching site's "countdown timer" reaches zero, the first stage of the rocket ignites and the rocket soars upwards. Then the second and third stages successively ignite sending the satellite together with the last stage up into a

near circular orbit at an altitude of 200 kilometers. This is the first stage. The second stage is when the satellite flies passed the airspace above the equator, the third stage ignites once more and propells the satellite and third stage into a large elliptical orbit. At this time, its near earth point is still at an altitude of 200 kilometers but its far earth point reaches an altitude of a near synchronous orbit, that is 35,800 kilometers. This type of interim orbit is called the synchronous transfer orbit. In the last stage, the satellite makes several orbits on the tranfer orbit and the engine on the satellite ignites at the near earth point of the orbit. The blast supplied by the engine causes the satellite to enter a quasi-synchronous orbit, also called the drift orbit (see Figure 2).

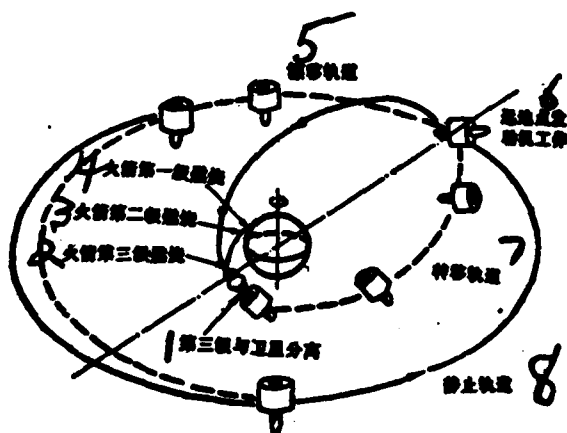


Fig. 2 Schematic of carrier rockets launching synchronous satellite.

Key: (1) Separation of third stage and satellite; (2) Combustion of rocket's third stage; (3) Combustion of rocket's second stage; (4) Combustion of rocket's first stage; (5) Drift orbit; (6) Engine operating at near earth point; (7) Transfer orbit; (8) Stationary orbit.

When the satellite reaches the quasi-synchronous orbit, we use the attitude control and position maintaining system to carry out orbit correction circularization and it finally enters the preset position of the stationary orbit.

Various Types of Carrier Rockets

At present, in the world, only the United States, the Soviet Union, Japan and the European Aerospace Bureau (this international organization is made up of eleven European nations including France, West Germany, England etc.) are able to use self-made rockets to launch earth synchronous satellites. Aside from American space aircraft, they used six types of single use carrier rockets (see Figure 3) and up to the end of 1982 successfully launched 151 earth synchronous satellites. It is worth pointing out that the launching of synchronous satellites with a space aircraft has already been realized.

We will now briefly introduce the above mentioned six types of carrier rockets :

1. The Delta Rocket. It is medium-small sized three stage multipurpose carrier rocket developed based on the early 1960's Thor single stage medium range missile of the United States. Its first and second stages both use liquid propellants and the third stage uses solid propellant. The greatest special feature of this type of carrier rocket series is the continuation of the use of existing achievements in engine models existing in the United States at the time. That is, on the basis of the Thor missile's booster stage, they longitudinally added stages and

transversely added boosters to form twelve types of rocket models. Among these, seven types were used to launch synchronous satellites. Its early period models could only send up 70 kilogram effective loads into synchronous transfer orbits but at the beginning of the 1970's the developed Delta-2914 and Delta-3914 caused their synchronous transfer orbit delivery capabilities to separately rise to 705 kilograms and 910 kilograms because of the transverse binding of nine solid boosters. The launching capability of the Delta-3914 was twelve times higher than the earlier models. Because its cost is relatively low and its reliability is relatively high, it has become the most numerous carrier rocket for launching synchronous satellites in the world. By the end of 1982, the Delta rocket was used to successfully launch 58 synchronous satellites.

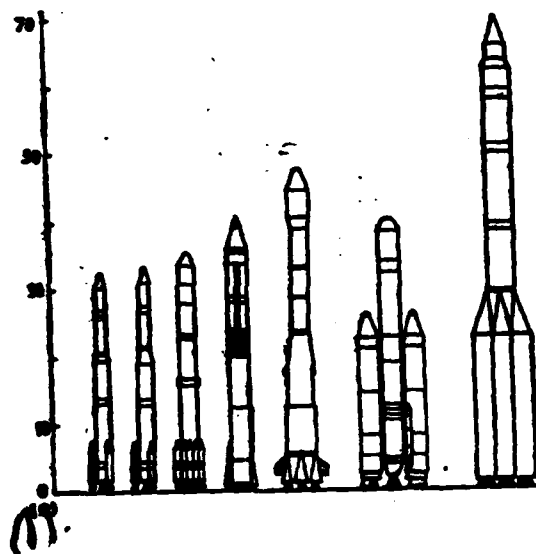


Fig. 3 (see next page)

Fig. 3 (continued) Contour drawing of several types of synchronous satellite carrier rockets. From left to right they are: N-1 (32.6 meters/900 tons); augmented thrust Delta (33.4 meters/91 tons), Delta-2914 (35.1 meters/133 tons); Atlas-Satittarius (40.3 meters/148 tons); Orion 1 (47.4 meters/212 tons); Tital III-C (40.5 meters/635 tons); Proton (70 meters/1,000 tons). (The numbers in the brackets indicate the rocket's altitude and takeoff weight).

Key: (1) Meters.

2. The Atlas Rocket. During the middle and late 1960's the United States took the earliest intercontinental missile - the Atlas booster stage as the basis and separately added two types of newly developed upper surface stages and formed two types of rockets, the Atlas-Agena and Atlas-Sagittarius.

The structure of the Atlas missile is different from that of most intercontinental missiles. It is a one stage semi-structure made up of one core stage rocket and its two laterally binded liquid booster engines. During takeoff, its three engines ignite simultaneously and when flying 120-125 seconds the two external engines are closed and cast aside. At this time, the core stage rocket engine continues to work. Looking at it from this angle, it seems to be a single stage rocket yet as regards its booster engine separating midway and being cast aside it also carries a second stage. Therefore, we call it the one and a half stage structure. This type of special feature can avoid the technical difficulties of high altitude ignition.

The Agena is a type of multipurpose upper stage developed by the United States Air Force at the beginning of the 1960's. It uses storable propellant uns dimethylhydrazine and red

nitric acid. At the end of the 1960's, it was used to launch synchronous satellites of the United States Air Force - the missile warning satellite. However, during the launching process, this type of upper stage is always joined into one whole with the satellite and therefore the effective load weight is greatly limited. After 1978, it was replaced by the Titan III-C which has much greater thrust.

The Sagittarius is the United States' first final stage rocket to use liquid hydrogen liquid oxygen high energy propellant. This type of upper stage has a vacuum thrust of 13 tons (the total thrust is supplied by two hydrogen oxygen engines) and also has restarting capabilities. The specific impulse is about 440 seconds. Because of the liquid hydrogen's ultralow temperature properties, for the problems of needing to restart as well as the synchronous ignition of the two hydrogen oxygen engines etc., by 1969 they used the Atlas - Sagittarius to successfully launch for the first time a synchronous satellite. By the end of 1982, they used it to launch a total of 27 synchronous satellites. This type of rocket can send an effective load of 1,850 kilograms into synchronous transfer orbit and the number of times it has been used is only second to that of the Delta rocket.

3. The Titan III-C. This type of rocket is a large scale liquid three stage carrier rocket developed by the United States at the end of the 1960's. It uses the two stage intercontinental missile Titan II booster stage as the basis and longitudinally series connects an interim stage and adds two

solid booster engines on the two sides.

When the Titan III-C launches a synchronous satellite, after the two side solid boosters and the first and second stages continue to work, the interim stage and satellite enter the docking orbit. At this time, the interim stage immediately adjusts the attitude, carries out first ignition when its second stage passes over the equator and the interim stage along with the satellite also enter the synchronous transfer orbit; afterwards, in the first far earth point of the transfer orbit, the interim stage ignites for a second time and the orbit dip changes to about zero degrees so that the interim stage and satellite enter a quasi-synchronous orbit. Therefore, the interim stage not only plays a role in the final stage rocket but also gives consideration to the function of the far earth point engine. Thus, the satellites which use the Titan III-C engine for launching do not require the mounting of the far earth point engine.

This type of rocket can directly send a 1,500 kilogram effective load into synchronous orbit. In the last few years, the thrust of this type of rocket has been raised to form a new model - the Titan 34D which can send a 1,850 kilogram effective load into synchronous orbit.

The major tasks of the Titan III-C are the one time deployment of eight satellites into synchronous orbit, the organization of military communication networks, the launching of missile warning satellites, the Lincoln Laboratory satellites and application satellites. By the end of 1982, it had

completed a total of 18 synchronous orbit launches.

4. The Proton Rocket. It is a completely liquid carrier rocket successfully developed in 1974 by the Soviet Union. It is also their only means of delivery used to launch synchronous satellites. It began to be developed in 1965 using the two stage rocket of the SS-9 intercontinental missile as the basis and was later gradually developed by adding on two upper stages. According to reports, the upper stages used unsymmetrical dimethylhydrazine and liquid oxygen as the propellants. After launching the Moon and Saturn probes as well as the early period Lipao Space Station, they gradually tested and verified the three stage and four stage Proton rockets. From 1974 to the end of 1982, this type of four stage carrier rocket was used to launch a total of 29 synchronous satellites and among these 26 were functional forming three types of communication satellite systems, the "Rainbow", "Horizon" and "Fluorescent Screen." Based on reports in foreign journals, the Proton rocket can send a two ton satellite into synchronous orbit.

5. The N Rocket. In 1970, Japan, based on the importation of the first and third stages of the Delta rocket of the United States, developed the N-I and N-II rockets (see Figure 4) which do not have great synchronous orbit delivery capabilities.

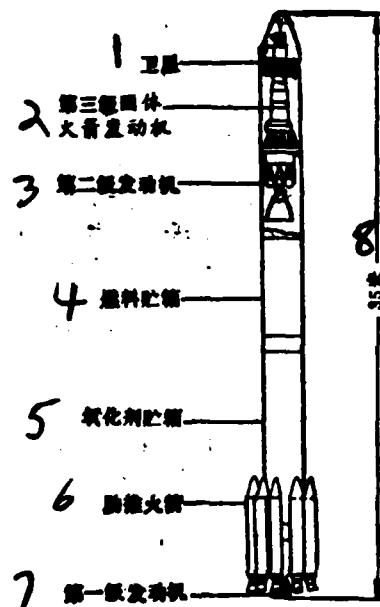


Fig. 4 Schematic of the structure of the N-II rocket.

Key: (1) Satellite; (2) Third stage solid rocket engine; (3) Second stage engine; (4) Fuel reserve tank; (5) Oxidizer holding tank; (6) Booster rocket; (7) First stage engine; (8) Meters.

In 1977, Japan successfully used the N-I rocket to launch a 130 kilogram technical test synchronous satellite. In 1981, they used an N-II rocket to successfully launch as much as a 300 kilogram synchronous meteorological satellite. Beginning in 1981, Japan started to develop a new type of carrier rocket, the H-I, which has a hydrogen oxygen upper stage. Its first stage still uses the N-II rocket, the second stage is a hydrogen oxygen engine with thrust of 10 tons and the third stage uses the Japanese made solid rocket engine with thrust of about 8 tons. Plans are that it will be successfully developed in 1986 and it will be able to send a 550 kilogram satellite into

synchronous orbit.

6. The Orion Rocket. It is a three stage large carrier rocket which was cooperatively developed by eleven Western European nations, predominately France, beginning in 1973. The propellants used by the first and second stages are unsymmetrical dimethylhydrazine and nitrogen tetroxide and the third stage uses liquid hydrogen and liquid oxygen. It was successfully developed by the end of 1981 after seven years. Both the first and second stage engines of the rocket are modifications of the Weijin II used on the Diamond rocket of France; the hydrogen oxygen engine HM-7 of the third stage was made by relatively large improvements based on the relatively mature HM-4 engine developed by France; the guidance system used the missile computer originally developed by the Sweden Aircraft Company for European rockets and the inertial platform developed by England for military aircraft; the manufacture and launching of the rockets also fully used the assembling equipment and launching facilities of former European rockets. The European Aerospace Bureau is now carrying out a series of improvements on this type of rocket and among them are the use of wrapped booster technology and the carrying out of retrieval tests of the rocket's first stage.

Development Trends

1. The demands for delivery capabilities have continually risen. Because the synchronous satellite has shown greater and greater superiority in realizing long-range communications,

television broadcasting and data relay etc., the demands for the communication capacities of satellites has doubled and redoubled and thus higher and higher demands for the delivery capabilities of rockets must also be brought forth. For example, the International Communications Satellite I of twenty years ago only weighed 38 kilograms and it could be satisfied by an early model of the Delta rocket; but the weight of the presently used International Communications Satellite II is already close to one ton and must use the Atlas-Sagittarius rocket for launching; recently, the weight of the International Communications Satellite VI developed by the Xiusi Company of the United States reached to about two tons but the abilities of the Atlas-Sagittarius fell short of expectations for it. Japan and the European Aerospace Bureau are trying in every way to raise the capabilities of their own existing carrier rockets.

2. The binding technique has been widely used. After the doubling and redoubling of the capabilities of the American's Delta rocket, it was fully shown that the binding technique was of significance in raising delivery capabilities. Japan synthesized the basis of the solid rocket technique of the United States and completely imitated this method. The modified models of the Titan III-C and Orion rockets of the United States both used this technique.

3. The use of high energy, low temperature propellants is a direction of development for the final stages of the rockets. The performance of the rocket's final stage directly influences the abilities of the entire carrier rocket, that is, it can

have a relatively large effect on the weight of the carrier rocket. Because the specific impulse of the liquid hydrogen and liquid oxygen reaches 430-440 seconds, it is 30-35% higher than commonly used liquid propellants; the specific weight of the liquid hydrogen is also very small, only one-ninth that of uns dimethylhydrazine. Therefore, it is most ideal for the upper stage of the carrier rocket to use this type of low temperature propellant. Following the use of this type of propellant by the last stage of the Sagittarius made by the United States, the European's Orion rocket and the H-1A rocket being developed by Japan all use high energy upper stages.

4. Reignition is a technical problem of the synchronous satellite carrier rockets. It took four years for the Sagittarius to resolve this problem; the Agena could not resolve this problem which caused launch failures; the Orion rocket used shooting range positions with advantageous conditions to avoid this problem and after Japan first controlled the related techniques of conventional liquid engines, they then went on to resolve the problem of restarting the hydrogen and oxygen engine.

END

DATE
FILMED

3 - 84

DTIC